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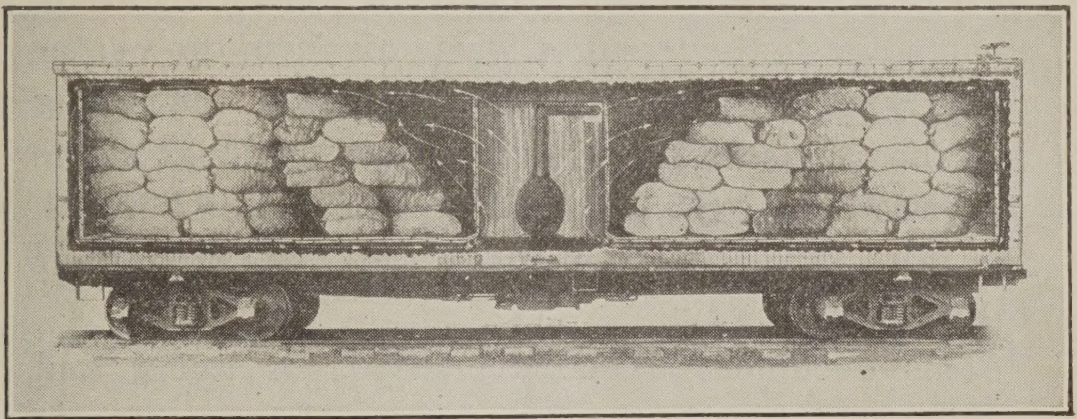
# Lining and Loading Cars of Potatoes for Protection from Cold

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Warm air circulation in correctly lined and loaded car of potatoes

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## SUMMARY

**A**PPROXIMATELY 75 per cent of all cars prepared to protect potato shipments from cold during the winter months are either lined or loaded incorrectly. Protection from cold depends largely upon a constant current of warm air from the heater directly to the ceiling, spreading between the ceiling and the top potatoes, thence through openings at the opposite end of the load down to the space beneath the false floor, and from there under the false floor to the heater again.

This document explains methods of lining and loading potatoes in the four principal types of cars with heaters and in refrigerator cars without heaters, under favorable shipping conditions.



## LINING AND LOADING CARS OF POTATOES FOR PROTECTION FROM COLD.

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### INTRODUCTION.

THESE RECOMMENDATIONS for lining and loading potato cars for protection of the shipments against cold are based upon commercial practices and the results of tests and inspections made by the Bureau of Markets of the United States Department of Agriculture. These were supplemented by conferences with many shippers, loaders, and railroad officials at shipping points in Maine, New York, Michigan, Wisconsin, and Minnesota, and at the markets of Philadelphia, New York, Chicago, and elsewhere. The principles here involved apply equally to cars from other shipping districts. The specific lining and loading directions, however, were designed primarily for cars with a heater in the doorway unless otherwise specified.

The investigations are being continued during the 1918-19 shipping season and supplemental recommendations resulting from these may be added from time to time.

### PRESENT CONDITIONS UNSATISFACTORY.

Of 400 cars of northern potatoes examined by Department representatives during December, 1917, and January, February, and March, 1918, approximately one-fourth were lined and loaded correctly. That is to say, only one in every four was so lined and loaded that the heater could properly protect the car even under ideal firing conditions. In the remaining three-fourths, there was always the danger of overheating the potatoes at the top of the load, and at the same time allowing the potatoes at the floor to freeze.

### THE BASIC PRINCIPLE.

When cars are being prepared with linings and heaters for protection against frost, it is important to remember that warm air weighs less than cool air. Warm air from the heater, therefore, rises directly to the ceiling over the heater and there flows and spreads out along the ceiling much as water poured into a long, flat pan flows and spreads over the bottom. If the



warm air is not allowed to get down to the floor, it will pile up between the potatoes and the ceiling, and the top potatoes will become overheated and blackened at the center. At the same time, the warm air is kept from the floor of the car and the

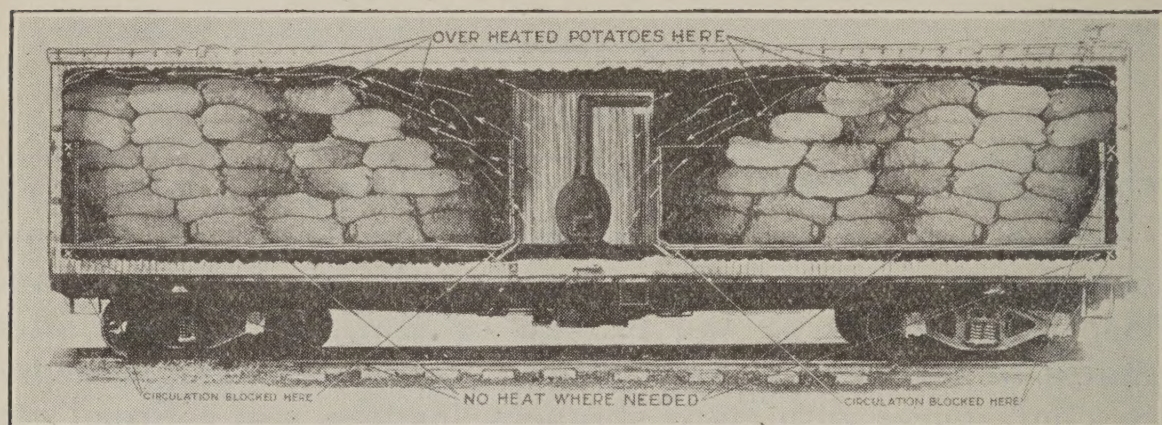


FIG. 1.—Warm air circulation in an incorrectly lined and loaded car of potatoes. The warm air from the stove cannot reach space beneath the false floor where it is needed.

potatoes there may freeze. Figure 1 indicates the usual places where the circulation is blocked. It is a comparatively simple matter for a heater to furnish enough warm air to protect a car of potatoes from freezing even in severe weather, but it seems to be difficult to have the car lining built and kept in such condition that this warm air can get down to the floor where it is needed.

To accomplish this, a complete air passage the full width of the car must be kept open around the load, as shown by the cover illustration. The following points, therefore, should be borne in mind: (1) The potatoes must not be loaded close enough to the ceiling to block any part of this circulation; (2) there must be a large, unobstructed opening for the warm air to pass down to the floor after it has spread the length of the ceiling from the heater; and (3) the false floor must be so constructed that this warm air can pass under it at all points back to the heater again. This circulation is slow and labored and is limited by the smallest opening in the space provided around the load, just as the effectiveness of a chimney is limited by the narrowest place in the flue. If the chimney flue is partially blocked by soot, the fire below will not draw well. Likewise, if the space around the load is partially blocked by the potatoes themselves, or by boards, shavings, or straw, the warm air will not circulate as it should. Shippers cannot make this point too clear to the employees who line and load their cars.



The following recommendations outline very satisfactory methods of lining and loading the principal types of cars for the protection from cold of potatoes in transit.

### BOX CARS.

#### ROUGH ESTIMATE OF LUMBER AND PAPER REQUIRED.

Following is an estimate of the lumber and paper needed to line an 8 by 8 ft. 6 in. by 36 ft. car with doors 5 feet wide:

13 pieces, 2 by 4 in. by 14 ft. long.

8 pieces, 2 by 6 in. by 16 ft. long.

1300 square feet of 1 in. lumber, 16 ft. long.

2250 square feet of building paper.

Saw the 13 pieces of 2 by 4 in. by 14 ft. into 26 pieces, 2 by 4 in. by 7 ft. Saw 6 inches off the length of each of the 8 pieces, 2 by 6 in. by 16 ft. Saw enough of the 16 ft. boards 1 in. thick into 8 ft. lengths to make a total width of 57 feet of 8 ft. boards.

Saw enough of the 16 ft. boards 1 in. thick into 6 ft. lengths to make a total width of 4 feet. This will leave a few 4 ft. lengths. Saw 1 foot off the remaining 16 ft. boards, leaving them 15 feet long.

#### METHOD OF LINING.

1. Paper or board over all broken places, loose joints, and any ventilators or unnecessary openings in the car floor, walls, and ceiling.

2. Paper the inside of the car ceiling, walls, and floor as illustrated in figure 2. All seams should lap not less than 4 inches. All seams on the walls should be lathed, as well as those on the ceiling when it is possible to do so. The paper on the ceiling should be held in place with laths nailed to the roof supports or to a light superstructure built in when there is nothing suitable already installed. Paper should be carefully folded over all corners and lines where the floor and walls join.

Close consideration of the principles involved in papering the ceilings of box cars makes its purpose and fundamental value clear. In the first place, box cars are seldom tight around the eaves and the warm air leaks out before it can pass from the ceiling to the ends of the car. It is an established fact, also, that the greater the difference in the temperature of two adjacent bodies, the more rapid the loss of heat from the warmer body will be. This means that the warmth of the air in the car will be lost more rapidly at the ceiling than at the floor. This statement does not imply that the air temperature near



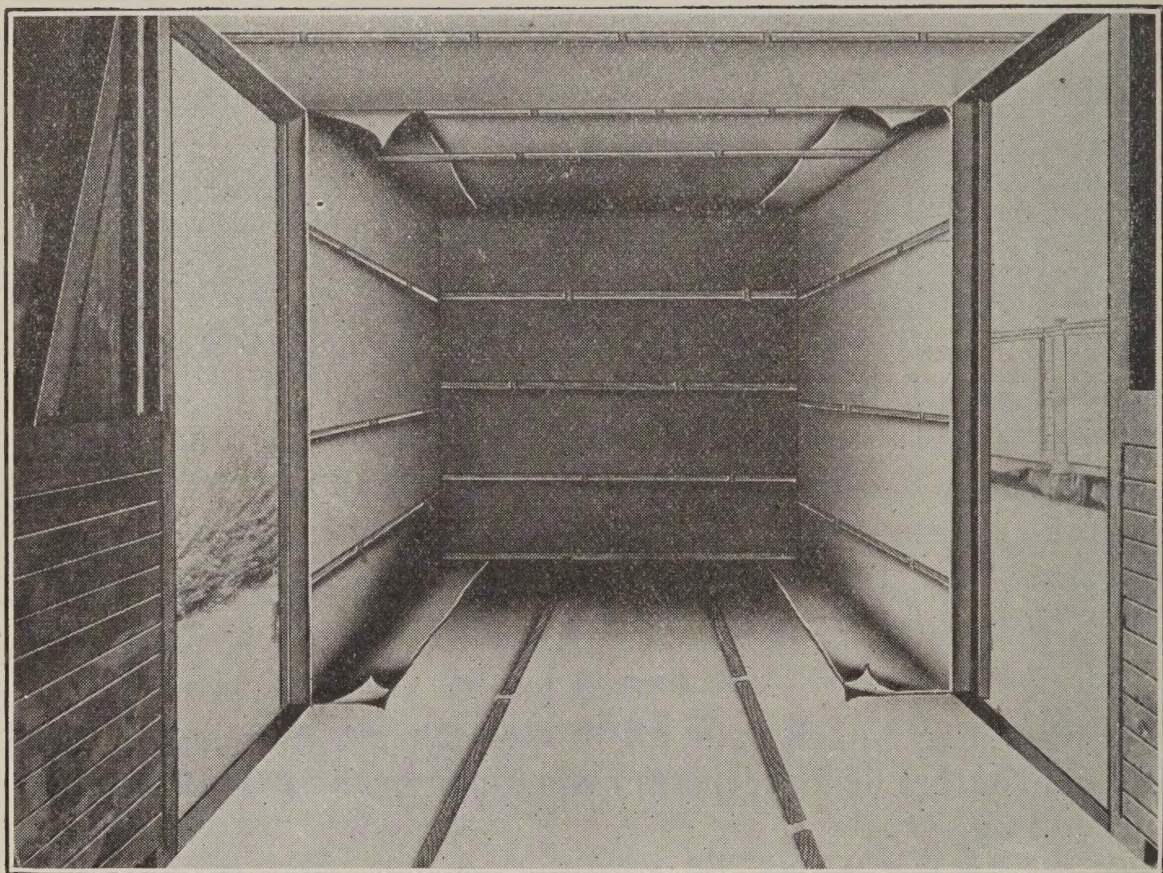


FIG. 2.—Properly papered box car. The ceiling, floor and walls of box cars should be papered before installing the false floor and walls.

the ceiling would become colder than that at the floor, but that the rate of loss of heat at the ceiling is greater. Inasmuch as we are dependent on the warm air at the ceiling, which later passes down the false end walls and then under the false floor, for keeping the potatoes warm at the floor, it is of vital importance that reasonable precautions be used to prevent the loss of heat.



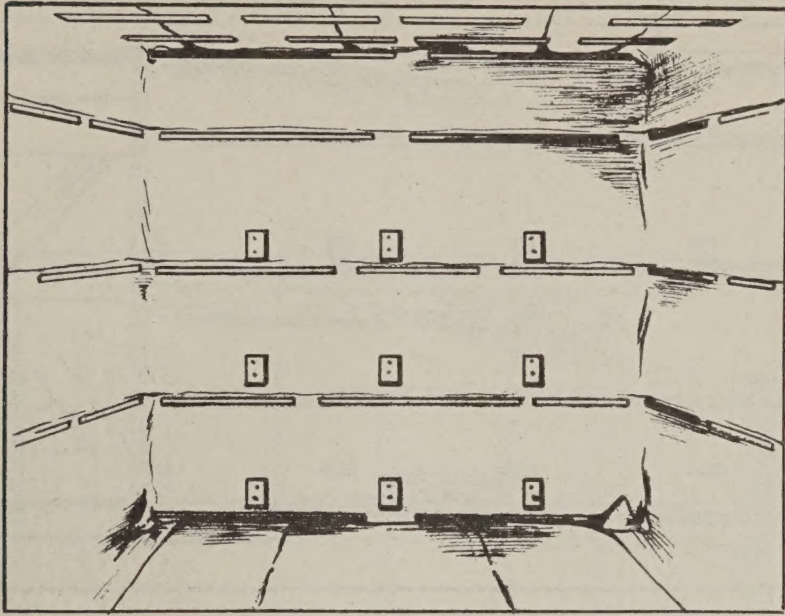


FIG. 3.—The false end wall studding blocked out from the end of the car.

3. Spike 9 blocks about 2 by 4 by 6 in. each to each end wall as illustrated in figure 3, so that when the studding is nailed to them it will leave a clear 6-inch space.

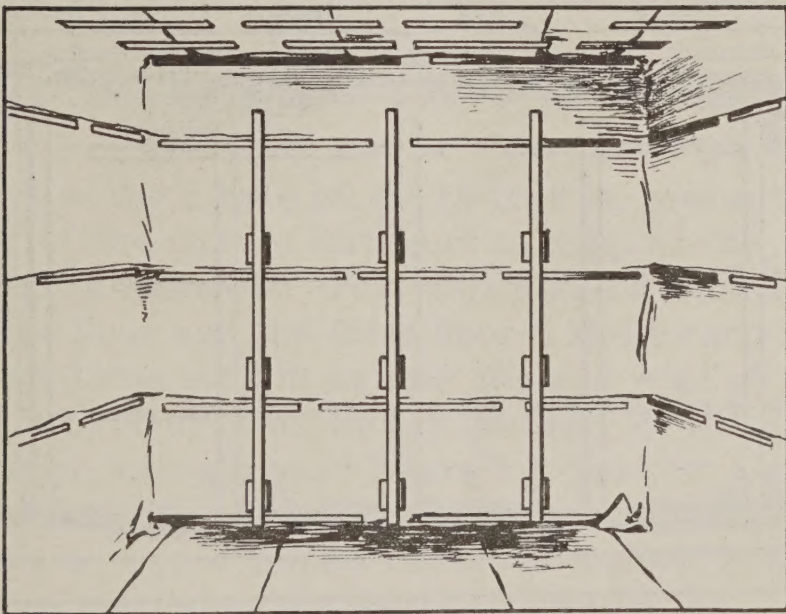


FIG. 4.—False end wall studding in place.

4. Spike 3 of the 2 by 4 in. by 7 ft. pieces to the blocks as illustrated in figure 4. This will make a 6-inch space between the car end wall and the false end wall.



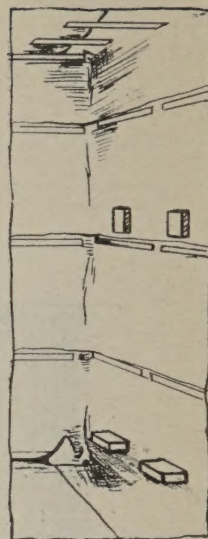
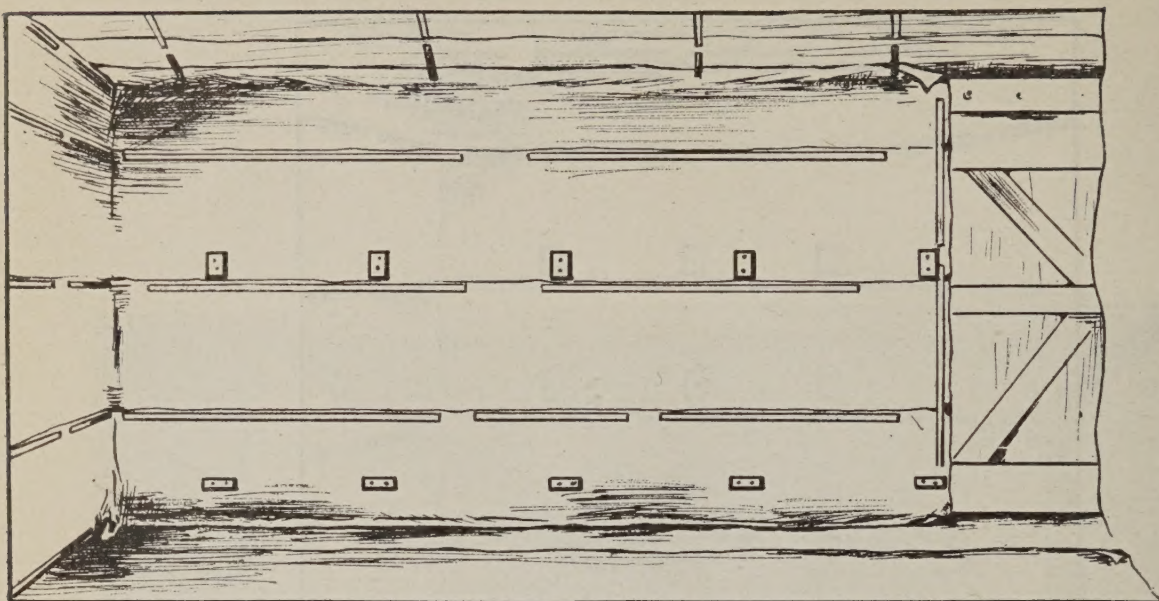


FIG. 5.—The false side wall studding blocked from the side of the car.

FIG. 5a.—Side view of blocks shown in fig. 5.

5. Spike 10 blocks about 2 by 4 by 6 in. each to each side of the car between the door and each end, as illustrated in figures 5 and 5a. The upper row should be nailed with the 4 by 6 in. surface against the car, and the lower row with the 2 by 6 in. surface against the car.

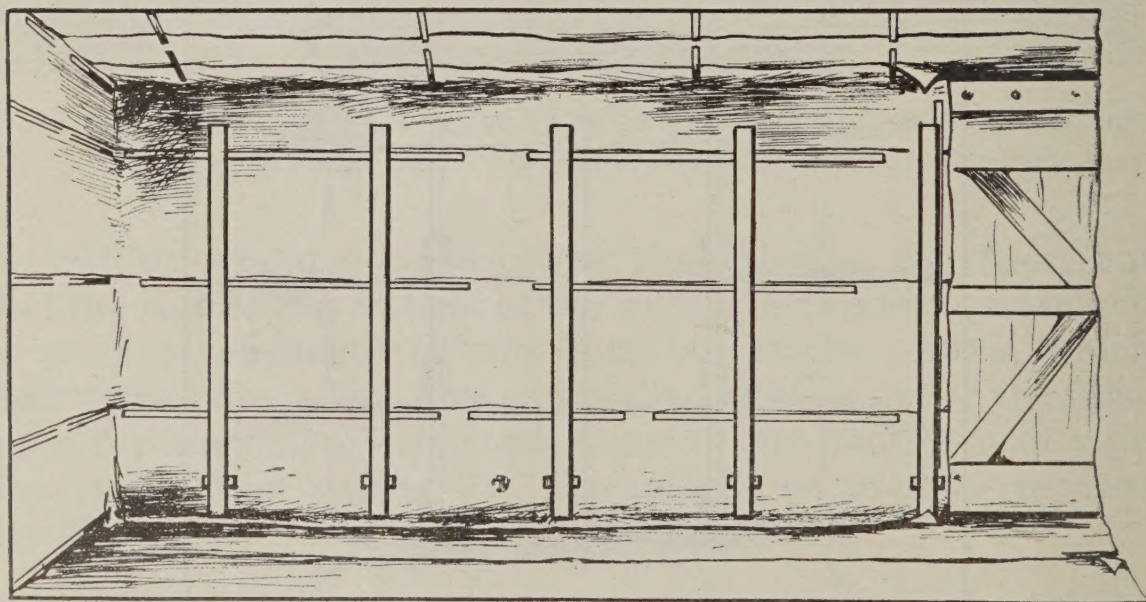


FIG. 6.—False side wall studding in place.

6. Spike 5 of the 2 by 4 in. by 7 ft. pieces to the blocks as illustrated in figure 6. This will make a 4-inch space between the false side wall and the car side wall at the top row of blocks, and a 6-inch space at the bottom row.



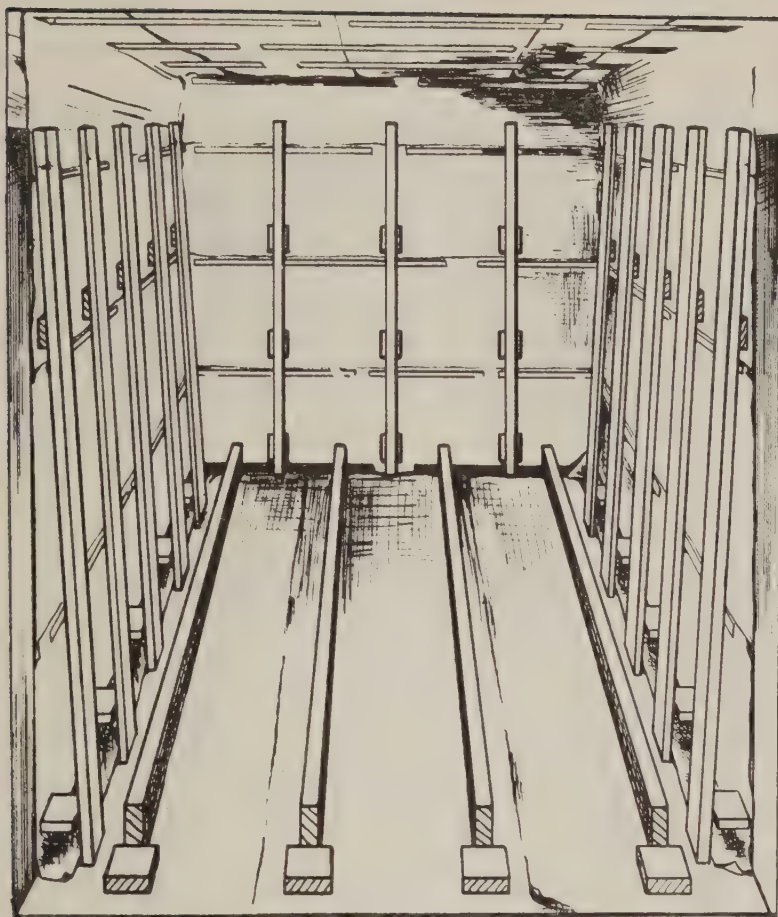


FIG. 7.—False floor stringers and blocks in place.

7. Spike 4 of the 2 by 6 in. by 15 ft. 6 in. pieces to the floor in each end of the car for stringers to support the false floor, as illustrated in figure 7. This will make a 6-inch space between the car floor and the false floor. Make certain that one end of the studding is tight against the end wall of the car.

8. Spike 2 by 4 by 4 in. blocks securely to the car floor at the end of each stringer as in figure 7. *Caution:* Do not run a strip across the ends of the stringers from side to side of the car. This is a very common cause of uneven heating, as it blocks a large portion of the warm air circulation.



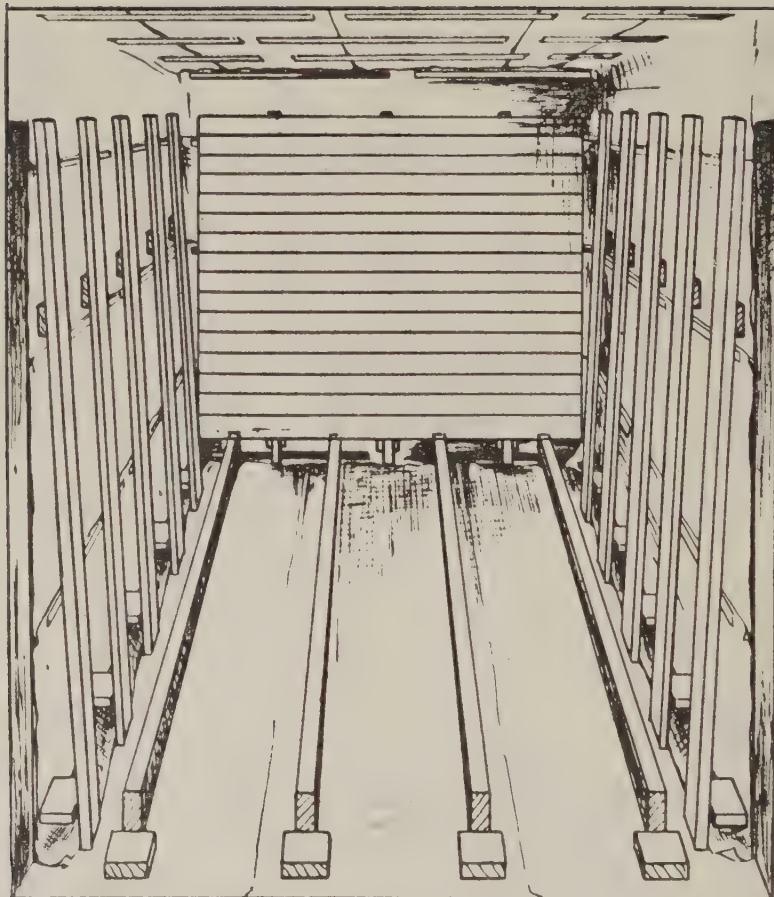


FIG. 8.—First layer of false end wall boards.

9. Nail 8 ft. lengths of the 1 in. boards to the studding at the end of the car (fig. 8). These boards should form a solid, tight false wall from the floor stringers to the top of the studding.





FIG. 9.—First layer of false floor boards.

10. Nail 8 ft. lengths of the 1 in. boards to the false floor stringers (fig. 9). These boards should form a solid, tight floor from the false end wall to the end of the stringers.



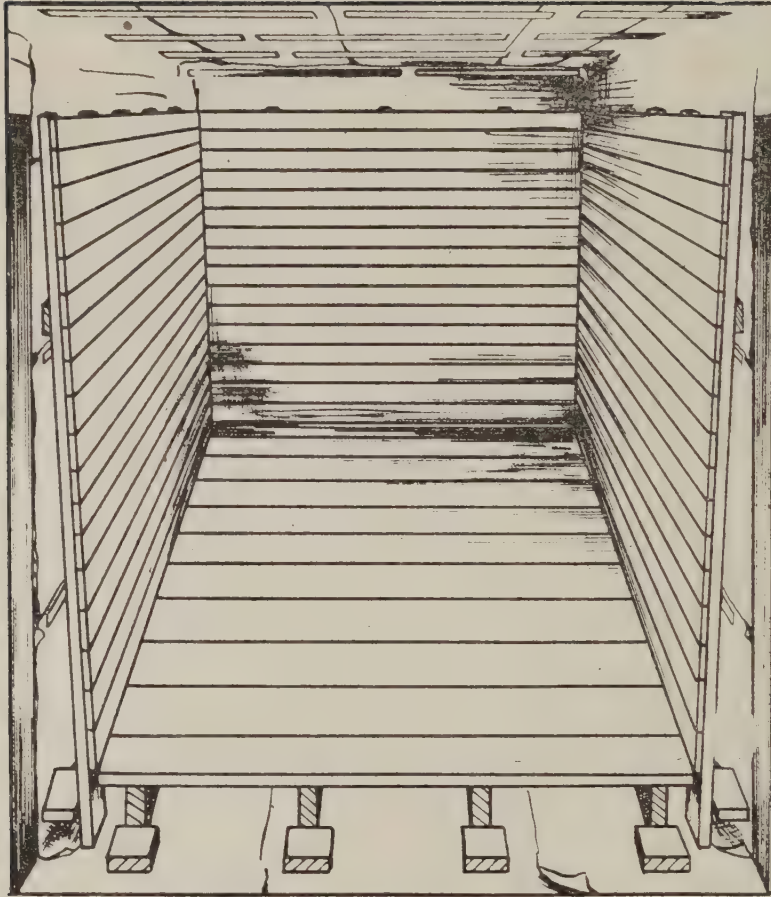


FIG. 10.—First layer of false side wall boards.

11. Nail 15 ft. lengths of the 1 in. boards to the false side wall studding (fig 10). These boards should form a solid, tight, false wall from the false floor to the top of the studding.

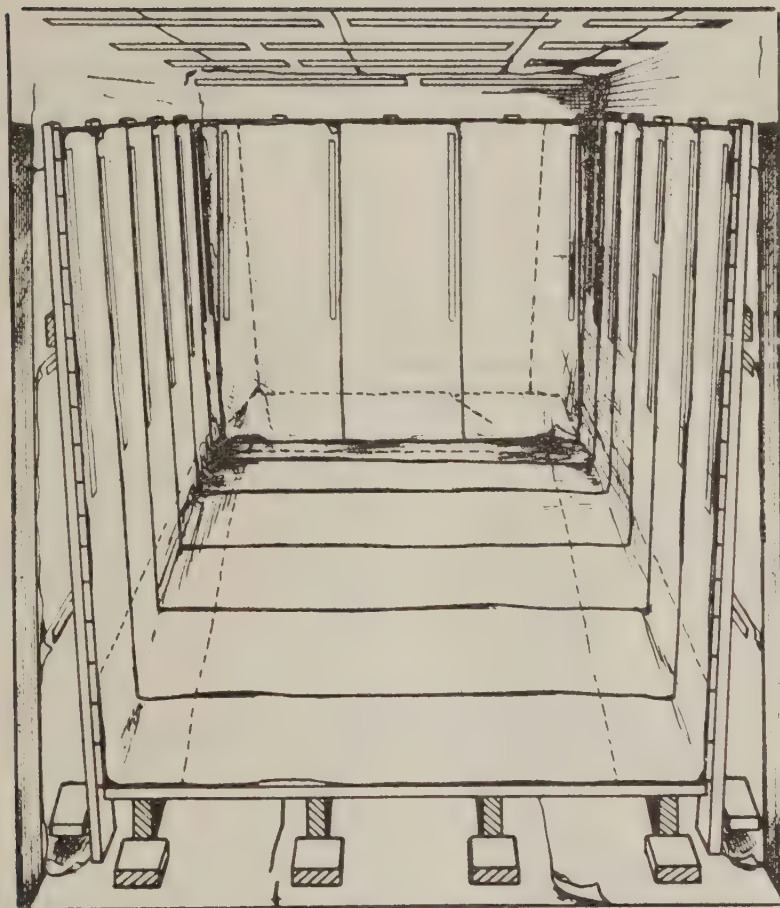


FIG. 11.—Layer of paper over first layer of false floor, side and end walls.

12. Paper the inside of the lining over the false floor and walls, lapping all seams 4 inches or more and carefully folding paper over all corners and lines where the false floor and false walls meet. Lath all seams on the false walls that come above the second layer of boards specified in paragraphs 13 and 15.

13. Nail 8 ft. lengths of the 1 in. boards to the false end wall, making a tight second layer of boards from the false floor up 30 inches (fig. 12).

14. Nail 15 ft. lengths of the 1 in. boards on the false floor, making a tight second layer of boards (fig. 12).



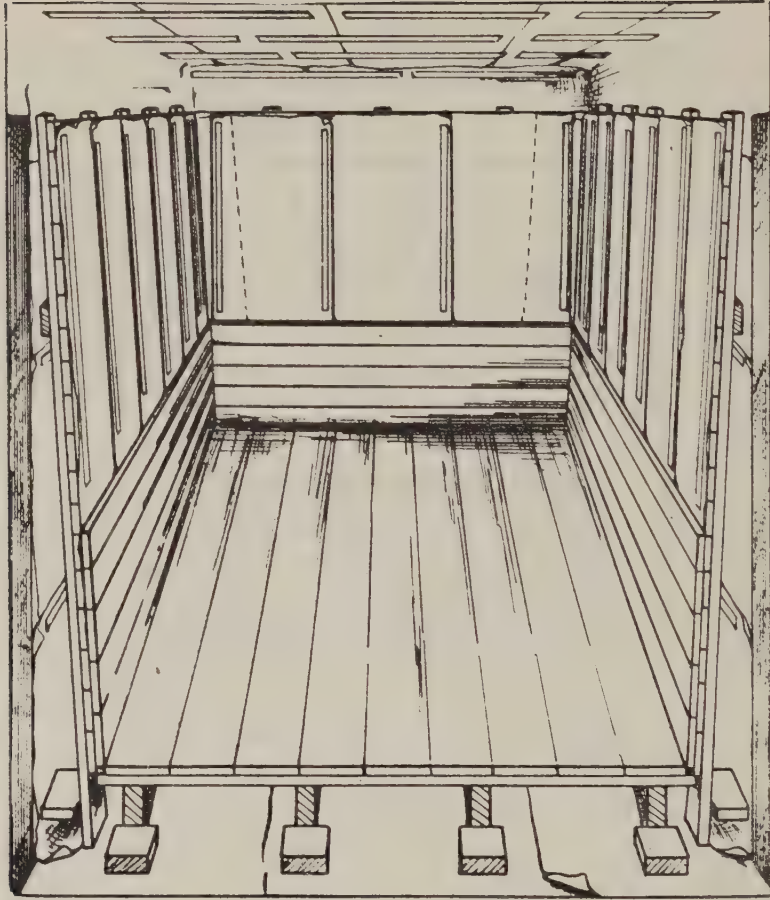


FIG. 12.—Second layer of false floor, side and end wall boards.

15. Nail 15 ft. lengths of the 1 in. boards to the false side wall, making a tight second layer of boards from the false floor up 30 inches (fig. 12).

16. Build in the fire door with the remaining 8 ft. and 4 ft. lengths, making sure that all joints are tight and that the opening for the stovepipe fits closely. If the outside temperature is freezing, it is often better that the fire door be put in and the stove set up before the false walls are installed, so that the car may be heated while the men are at work.

17. Set up the stove in the doorway, fastening it securely to the floor. Wire the stovepipe carefully in place. The regulations of each railroad should be followed in this respect.



## LOADING.

18. Heat the car for at least six hours directly before loading it and longer if possible when the outside temperature and boards of the lining are extremely cold. When exceptionally warm weather conditions prevail, this is not always necessary.

19. Load potatoes in sacks somewhat as indicated by the illustration on the cover. At no place should the sacks in any portion of the load come closer than 8 inches to the ceiling when loaded.

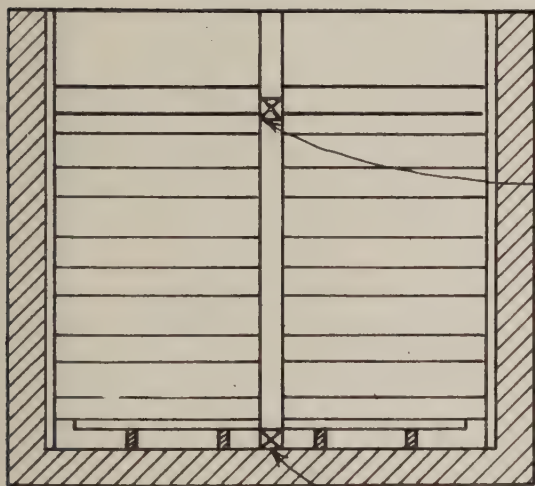


FIG. 13.—Bulkhead across car at doorway to hold bulk potatoes.

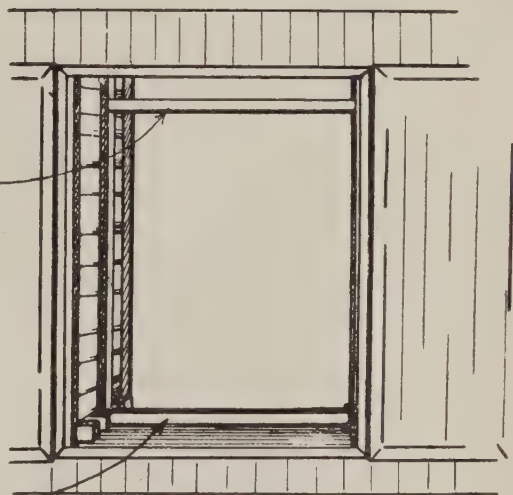


FIG. 13a.—Bracing to hold bulkheads in place.

20. In loading bulk potatoes build up the bulkhead at the doorway (fig. 13) as necessary. The bulkheads should be made of good 1 in. boards, or heavier, so cut that they will fit and may be nailed behind 2 by 4 in. uprights nailed to each false side wall and a 4 by 4 in. upright at the center. The center uprights of the bulkhead should be braced apart with not less than 2 pieces of 4 by 4 in. studding driven in place and well nailed (fig 13a).



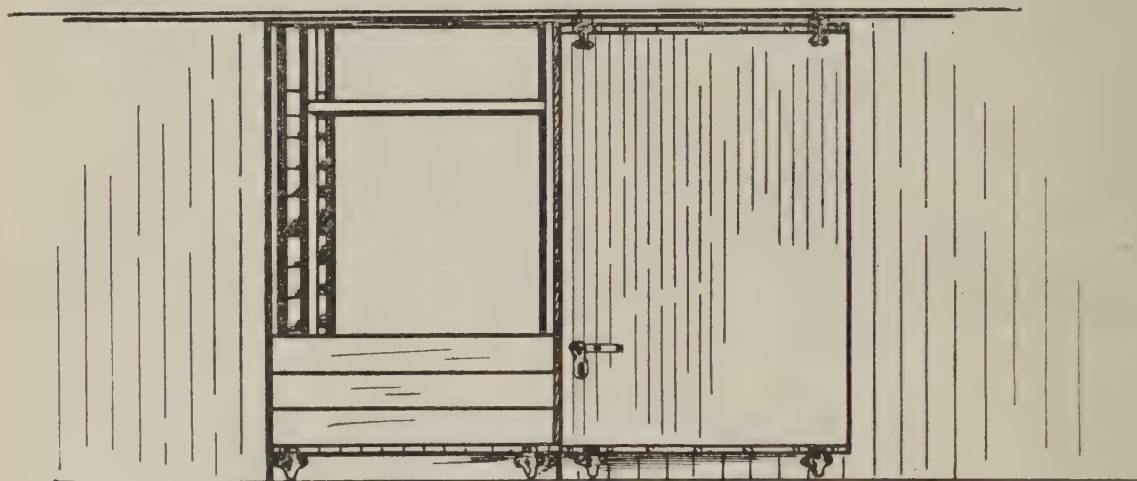


FIG. 14.—Wind boards to keep out cold winds.

21. Nail the 6 ft. lengths of 1 in. boards across each door, making a solid partition from the door sill up to 24 inches (fig. 14). Before the car is shipped, it is well to fill the space between the partition and the car door with sawdust or other filler when it is not necessary to open the car door in transit. This will tend to keep out cold winds.

22. Frozen fuel should not be loaded into a car when it is possible to avoid it. Never allow frozen fuel to rest in direct contact with any potatoes. Load the fuel in such a manner that it will not block any of the circulation from beneath the false floor. This may require the use of boards laid across the floor in front of the doorway with the ends resting on the false floors. Supply abundant fuel for the trip.

23. Paper around the doors and fire board except where it will hinder the fireman from entering the car.

#### PRODUCE CARS AND CERTAIN OTHER INSULATED CARS.<sup>1</sup>

Because of the irregularity in the dimensions of cars of this type, it is impossible to give estimates for lumber required for use in all cars. The following recommendations are made:

1. All ventilator openings, broken places, loose joints, drain trenches or runways along the floor, drain pipes, etc., must be carefully plugged or otherwise boarded or papered over.

<sup>1</sup> This includes all insulated cars provided with tight doors but not equipped with end ice bunkers, and also refrigerator cars with end ice bunkers, which experience has shown to be provided with so little insulation that in the opinion of the shipper it is necessary to paper over the ventilation openings through the bulkheads.

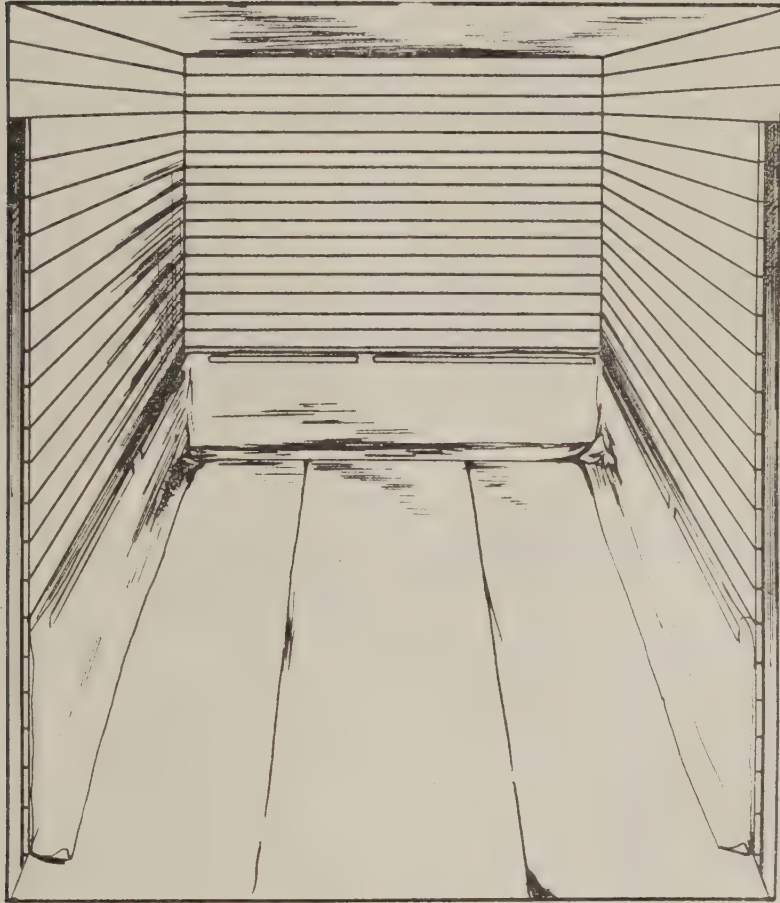


FIG. 15.—Paper the floor and the side and end walls of produce cars up 24 inches.

2. Paper the car floor and walls to a height of 24 inches. Lap the seams not less than 4 inches. The paper on the walls should be held in place with lath and should be carefully folded over all corners and lines where the floor and walls join (fig. 15).

3. Spike<sup>1</sup> 9 blocks 2 by 4 by 6 in. each to each of the end walls as illustrated in figure 3, so that when the studding is nailed to them it will leave a clear 6-inch space

4. Spike 3 pieces of 2 by 4 in. studding to the blocks as illustrated in figure 4. This will make a 6-inch space between the car end wall and the false end wall. The studding should extend from the floor to about 8 inches from the ceiling.

<sup>1</sup> See footnote at bottom of page 23 under paragraph 3 describing the method of preparing refrigerator cars.



5. Spike four pieces of 2 by 6 in. studding to the floor in each end of the car for stringers to support the false floor, as illustrated in figure 7. This will make a 6-inch space between the car floor and the false floor. Make certain that one end of the studding is tight against the car end wall. The stringers should extend from the end wall of the car to about even with the doorposts.

6. Spike 2 by 4 by 4 in. blocks securely to the car floor at the end of each stringer (fig 7.). *Caution:* Do not run a strip across the ends of the stringers from side to side of the car. This is a very common cause of uneven heating, as it blocks a large portion of the warm air circulation.

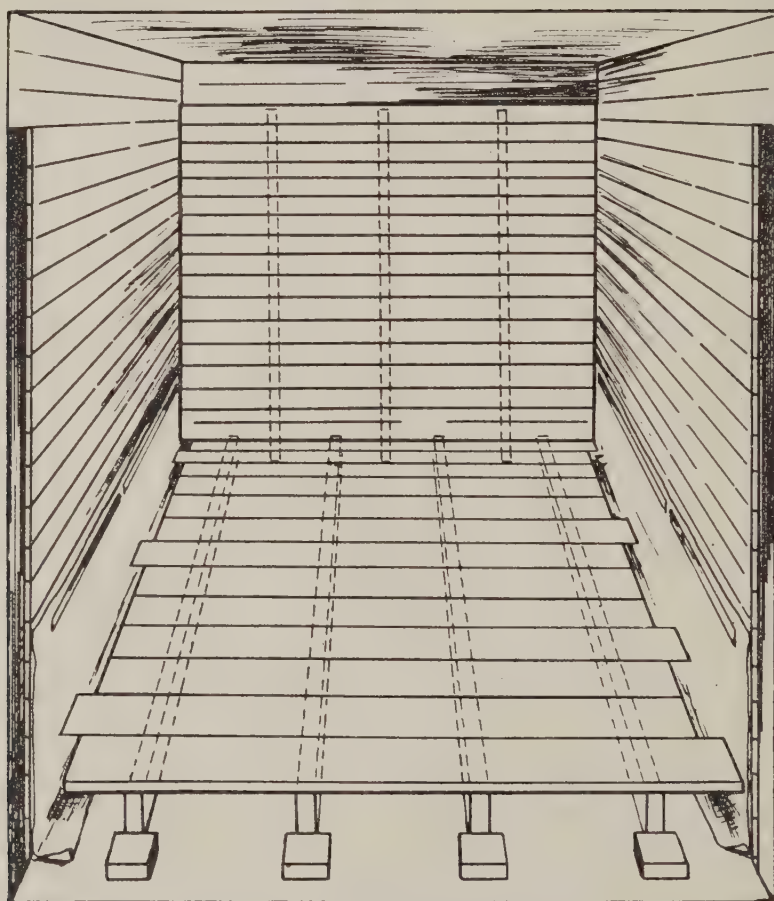


FIG. 16.—False floor (option "b" of paragraph 8) and end wall in produce car.

7. Nail 1 in. boards to the studding at the end of the car (fig. 16). These boards should form a solid, tight false wall from the floor stringers to the top of the studding and should extend to about 8 inches below the ceiling.

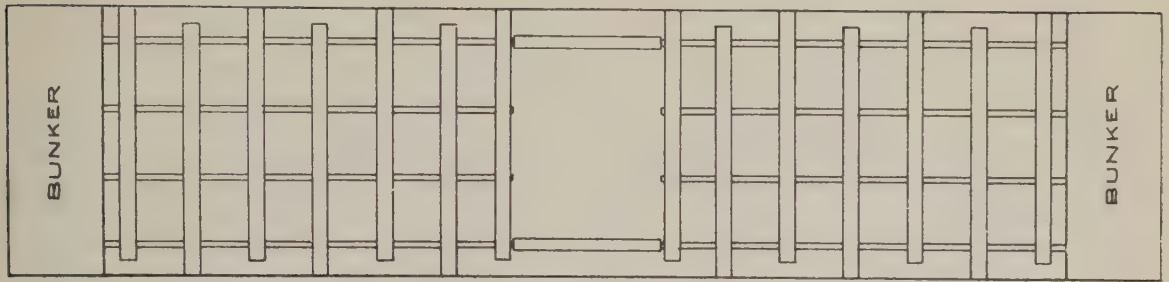


FIG. 17.—False floor supports (option "a" of paragraph 8).

8. (a) Nail sufficient 1 in. boards, or thicker, across the stringers (fig. 17), spaced so as to support the false floor; or (b) make the false floor entirely of one layer of boards cross-wise on the stringers as illustrated in figure 18, in which case no space should be left between the boards. Cars already equipped with 4 in. false floors with stringers running length-wise do not require, of course, any additional false floor.

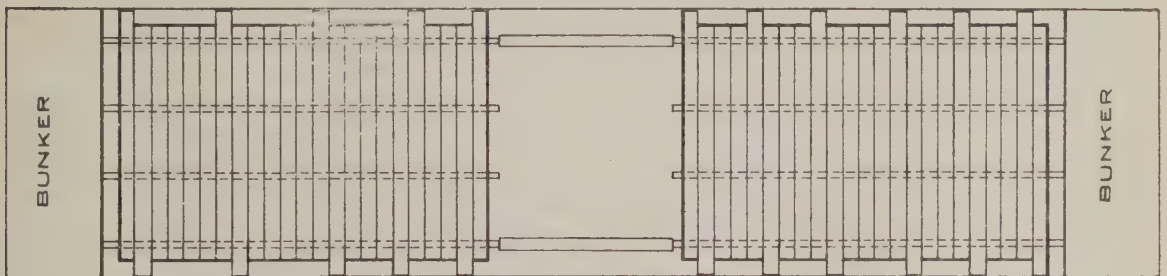


FIG. 18.—False floor (option "b" of paragraph 8).

9. If option "b" in paragraph 8 above is used, nail lengths of  $1\frac{1}{2}$  in. boards on the supports, making a tight, false floor from the false end wall to about even with the doorposts (fig. 18). *Note:* If the potatoes are to be shipped in bulk, the false end walls (described in paragraph 7) must fit tightly against the car side walls (fig. 16).

10. Paper the inside of the lining over the false floor and the side walls to a height of not less than 24 inches, lapping all seams 4 inches or more and carefully folding paper over all corners and lines where the false floor and walls meet.

11. Fire doors should be carefully fitted and made tight by the use of burlap or paper. It is recommended that the door to the left, when facing the car from the outside, be the one to be replaced by the fire door. The fire door should then be built on the inside. This will permit the right-hand door to be opened and closed, and the car may be entered from either side. If this is done, it is necessary to use burlap along one side of the fire door to make a tight joint with the car door when it is closed. If the outside temperature is freezing, it is



often better for the fire door to be put in and the stove set up before the false walls are installed, so that the car may be heated while the men are at work.

12. Set up the stove in the doorway, fastening it securely to the floor. Wire the stovepipe carefully in place. The regulations of each railroad should be followed in this respect.

13. Heat the car for at least six continuous hours directly before loading, and longer if possible when the outside temperature and boards of the lining are extremely cold. When unusually warm weather conditions prevail this is not always necessary.

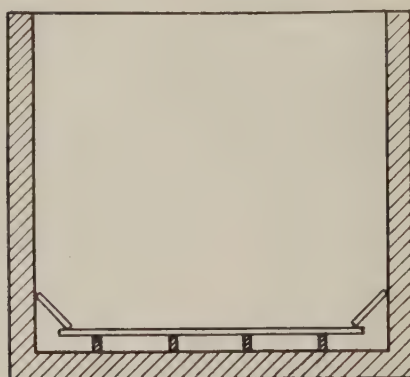


FIG. 19.—Boards to keep the bottom potatoes away from the sides of the car. This greatly reduces damage by freezing.

14. The potatoes at the floor should be loaded not less than 6 inches away from the sides and ends of the car. In bulk potato shipments, this may be accomplished by boards not less than 10 inches wide or by racks placed at an angle along the walls with one edge nailed to the false floor and the other resting (not nailed) on the side of the car (fig. 19). In sacked potato shipments the same method may be used, or the bottom layer of sacks may be loaded away from the sides and ends of the car and held in place by the layers above. This method is illustrated in figure 20.





FIG. 20.—Sacked potatoes loaded away from the sides of the car to prevent freezing.

15. Load potatoes in sacks somewhat as indicated by the cover illustration and figure 20. At no place should the sacks in any portion of the load come closer to the ceiling than 8 inches when loaded.

16. In loading bulk potatoes, build up the bulkheads at the doorway (fig. 13), as necessary. The bulkheads should be made of good 1 in. boards, or heavier, so cut that they will fit and may be nailed behind 2 by 4 in. uprights nailed to the doorposts and a 4 by 4 in. upright at the center. The center uprights of the bulkheads should be braced apart with not less than 2 pieces of 4 by 4 in. studding driven in place and well nailed (fig. 13a).



17. Frozen fuel should not be loaded into a car when it is possible to avoid it. Never allow frozen fuel to rest in direct contact with any potatoes. Load the fuel in such a manner that it will not block any of the circulation from beneath the false floor. This may require the use of boards laid across the floor in front of the doorway with the ends resting on the false floors. Supply abundant fuel for the trip.

18. Paper around the doors and fireboard except where it will hinder the fireman from entering the car.

**REFRIGERATOR CARS (EXCEPT AS PROVIDED FOR UNDER "PRODUCE CARS, ETC.", OR UNDER "INSULATED CARS SHIPPED WITHOUT HEATERS").**

1. All ventilator openings, broken places, loose joints, drain pipes, etc., should be carefully plugged or otherwise boarded or papered over, except that when oil heaters are used the drain pipes may be left open.

2. Paper over the floor and side walls, but not over the end walls, to a height of not less than 24 inches with heavy paper (fig. 15), except when prevented by permanent false floors which are hinged or fastened to the car. Paper on the side walls should be held in place with lath. The sheets should lap not less than 4 inches and be folded carefully over all corners and lines where the floor and side walls meet. In no case should any of the bunker bulkhead openings be papered over or otherwise blocked, except where false end walls are used as provided for under "Produce Cars, etc.", or "Cars Shipped Without Heaters."

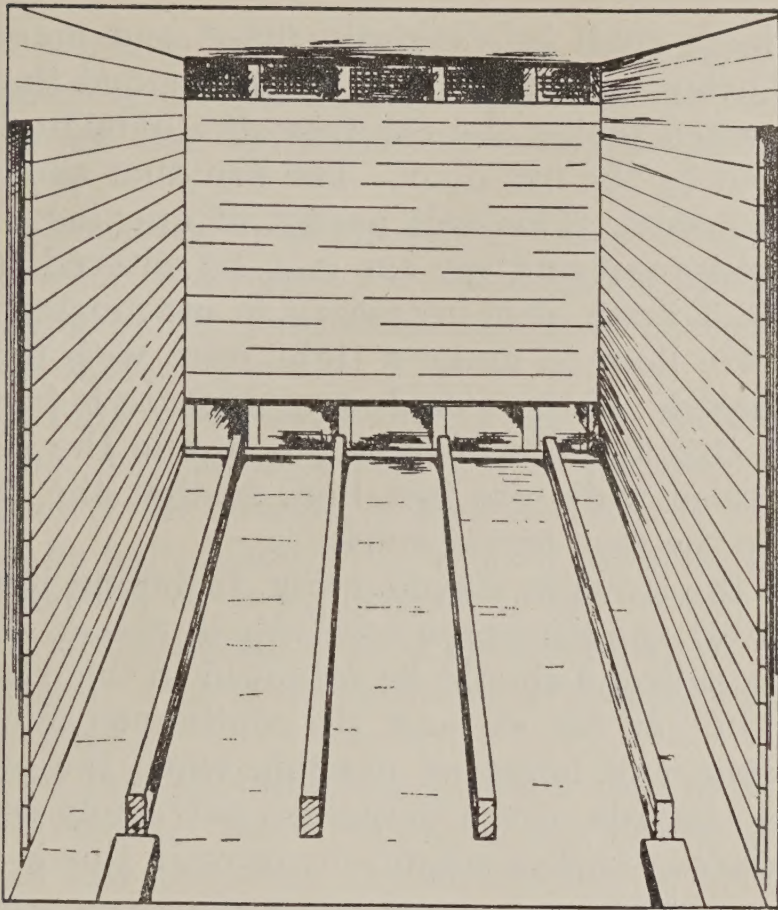


FIG. 21.—False floor stringers in place in well-constructed refrigerator car.

3. Lay 4 pieces of 2 by 4 in. studding on the floor in each end of the car for stringers, the 2 in. side against the floor (fig. 21). Do not nail these to the floor.<sup>1</sup> The stringers should be evenly spaced parallel to the sides of the car with one end tight against the ice bunker bulkheads. The two outside stringers at each end must be in the same straight line.

4. Fit a 2 by 4 in. piece as a brace between each of the two sets of stringers described in the last sentence of paragraph 3 (figs. 17, 18, and 21). These braces should be laid with the 4 in. side flat on the floor and the ends securely toenailed to the stringers. Do not nail these to the floor.

5. Nail good 1½ in. boards, or heavier, across the stringers, making a solid false floor from the door posts to within 6 inches of the ice bunker bulkheads (fig. 18). It is important that this 6-inch space between the ends of the false floors and the bulkheads be left. This is shown in figure 22. Each board must be well nailed to all four stringers to keep them from turning on side. At least occasional boards must extend to each side wall to keep the false floor from shifting sidewise.

<sup>1</sup> The new refrigerator car equipment of the country is of generally very good construction and well insulated. Driving nails through the car floors, walls or ceilings destroys the insulation. Such practices cannot be condemned too severely. A high grade refrigerator car represents a large initial and upkeep cost, and it transports perishable produce of a much greater value annually. The carriers and shippers must co-operate to save this high-grade equipment. The obligation is mutual and is a moral one.



6. Fire doors shall be carefully fitted and made tight by the use of burlap or paper. It is recommended that the door to the left, when facing the car from the outside, be the one to be replaced by the fire door. The fire door should then be built on the inside. This will permit of opening and closing the right-hand door, and the car may be entered from either side. If this is done, it is necessary to use burlap along one side of the fire door to make a tight joint with the car door when it is closed. If the outside temperature is freezing, it is often better that the fire door be put in and the stove set up before the false walls are installed, so that the car may be heated while the men are at work.

7. Set up the stove in the doorway, fastening it securely to the floor. Wire the stovepipe carefully in place. The regulations of each railroad should be followed in this respect.

8. Heat the car for at least six continuous hours directly before loading, and longer if possible when the outside temperature and boards of the lining are extremely cold. When unusually warm weather conditions prevail, this is not always necessary.

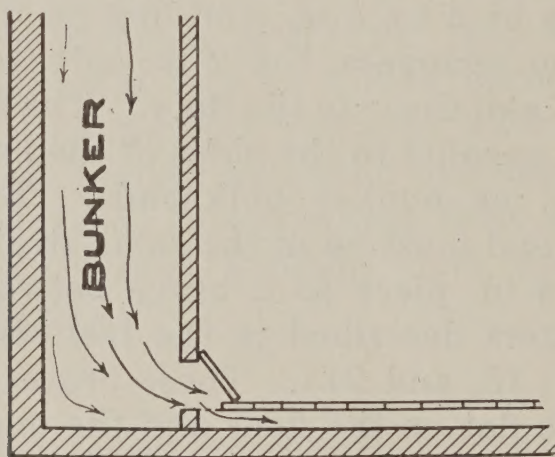


FIG. 22.—Keep this space open.

9. The potatoes at the floor should be loaded not less than 6 inches away from the sides and ends of the car. In bulk potato shipments this may be accomplished by boards not less than 10 inches wide, or by racks placed at an angle along the walls with one edge nailed to the false floor and the other resting (not nailed) on the side of the car (fig. 19). In sacked potato shipments the same method may be used, or the bottom layer of sacks may be loaded away from the sides and ends of the car and held in place by the layers above. This method is illustrated in figure 20. *Caution:* Where boards are used



to give this protection at the bulkheads, care must be taken to leave the opening for ventilation 4 inches in the clear from the bunker through the ventilation opening and under the false floor (fig. 22).

10. Load potatoes in sacks somewhat as indicated by the cover illustration and figure 20. At no place should the sacks in any portion of the load come closer to the ceiling than 8 inches when loaded.

11. Load bulk potatoes, building up the bulkheads at the doorway (fig. 13) as necessary. The bulkheads should be made of good 1 in. boards, or heavier, so cut that they will fit and may be nailed behind 2 by 4 in. uprights nailed to the doorposts and a 4 by 4 in. upright at the center. The center uprights of the bulkheads should be braced apart with not less than 2 pieces of 4 by 4 in. studding driven in place and well nailed (fig. 13a).

12. Frozen fuel should not be loaded into a car when it is possible to avoid it. Never allow frozen fuel to rest in direct contact with any potatoes. Load the fuel in such a manner that it will not block any of the circulation from beneath the false floor. This may require the use of boards laid across the floor in front of the doorway with the ends resting on the false floors. Supply abundant fuel for the trip.

13. Paper around the doors and fire board except where it will hinder the fireman from entering the car.

#### INSULATED CARS SHIPPED WITHOUT HEATERS.

Comparatively short-haul potato shipments without the use of heaters are made in certain sections. This method should be adopted only in high-grade refrigerator cars in good condition.

The cars should be prepared as are refrigerator cars except for the heater and fuel. If there is any possibility that the car may have to be heated later, the space beneath the false floor should be kept clear from all obstructions and the ventilation openings through the ice bunker bulkheads should not be papered over.

In addition to these precautions the following recommendations are made:

1. Heat the car for a period of not less than 12 hours directly before loading, except that when unusually warm weather conditions prevail this is not always necessary.



2. Use not less than two heavy layers of straw with alternate layers of building paper for added insulation between the potatoes and the false floor and car walls.

3. Ship potatoes in this way only when the temperature is about 40 degrees F.

#### CARS WITH HEATERS PERMANENTLY INSTALLED.

Certain of the heater cars in use protect potato shipments from the cold quite satisfactorily. It is expected that the future will bring great improvements in this class of railway equipment.

Heaters permanently installed as a part of the car equipment can have the decided advantage of applying the heated air from beneath the car directly to the space beneath the false floor where it is needed, while with the temporary heaters in use the heated air must first pass to the ceiling before circulating down to the floor. These cars come with false floors and walls installed and are ready for loading. At the present time their use for potatoes in the United States is restricted mostly to shipments from Maine, Wisconsin, Minnesota, North Dakota and Washington.

Approximately the same rules should be used in loading these cars as in loading refrigerator cars.

#### CAR LOADING DOCUMENTS OF THE U. S. BUREAU OF MARKETS.

Factors in Transportation of Strawberries from the Ozark Region. Markets Doc. 8.

Loading and Transporting Western Cantaloupes. Markets Doc. 10.

Heavy Loading of Freight Cars in the Transportation of Northwestern Apples. Markets Doc. 13.

Loading American Grapes. Markets Doc. 14.

Copies of these documents may be had as long as the available supply lasts by application to the Division of Publications, United States Department of Agriculture, Washington, D. C.